agricultural research

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Earthly Realities

The green leaf governs the economy of nature. Every living creature, with minor exceptions, is utterly dependent upon plants and photosynthesis. Powered by sunlight, the chlorophyll in leaves turns carbon dioxide and water into the sugar that ultimately sustains all life.

Modern science, with its great discoveries, stands humbled by the awesome food-producing ability of the plant kingdom. Certainly no single chemical reaction is more vital to man than photosynthesis. Every year plants take up vast tonnages of carbon released by decaying wastes and transform it into plant material, and in the process recharge the biosphere with life-sustaining oxygen. As partakers of these benefits we should always remember that, biologically speaking, we are plant parasites—although we have long been cotenants of the Earth, plants existed before man and need him not at all. The earthly realities are that man cannot really hold dominion but must live in harmony with the natural world.

Many of our activities adversely affect the well-being of plants. It is a perverse paradox that we damage plant life most where we need it most, around our burgeoning population centers. We can alleviate much of this damage through an awareness of the interdependencies that make up the unity of life and acting accordingly. The building of homes and roads without regard to drainage patterns, for example, can drown nearby plant communities. Once construction is completed, the tramp of feet and the roll of traffic, often on seemingly invulnerable sites, can exact a heavy toll of plant life by compacting the soil, lessening its capacity to harbor water and air. Every winter, tons of salt are spread on streets and highways, polluting the water supply of many plants and eventually killing them because their roots cannot take up salt water.

Even the mundane trappings of modern life do their share of damage. Air conditioners emit strong drafts that can rob cells of their turgidity, thus drying off the plant. And kitchen fans propel cooking fats and oils outdoors where they clog leaf surfaces and interfere with plant respiration.

Nature's power of renewal heals many abuses. Even so, the quality of human life would gain if we realized that man lives because he is surrounded by plants. We can create harmony between man and nature by practicing the kind of stewardship exemplified by French farmers who live in graceful villages amid ever fertile fields tilled well over 4,000 years. The gift of green can be husbanded with wisdom and knowledge.—*R.P.K.*

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COVER: Ovipositing completed, this tiny (2 to 3 mm. long) parasitic wasp, *Spalangia endius*, feeds on blood rising to the surface of wound it inflicted on a house fly pupa. Scientists are evaluating the wasp as a control agent of house flies (0176X131–22). Article begins on page 8.

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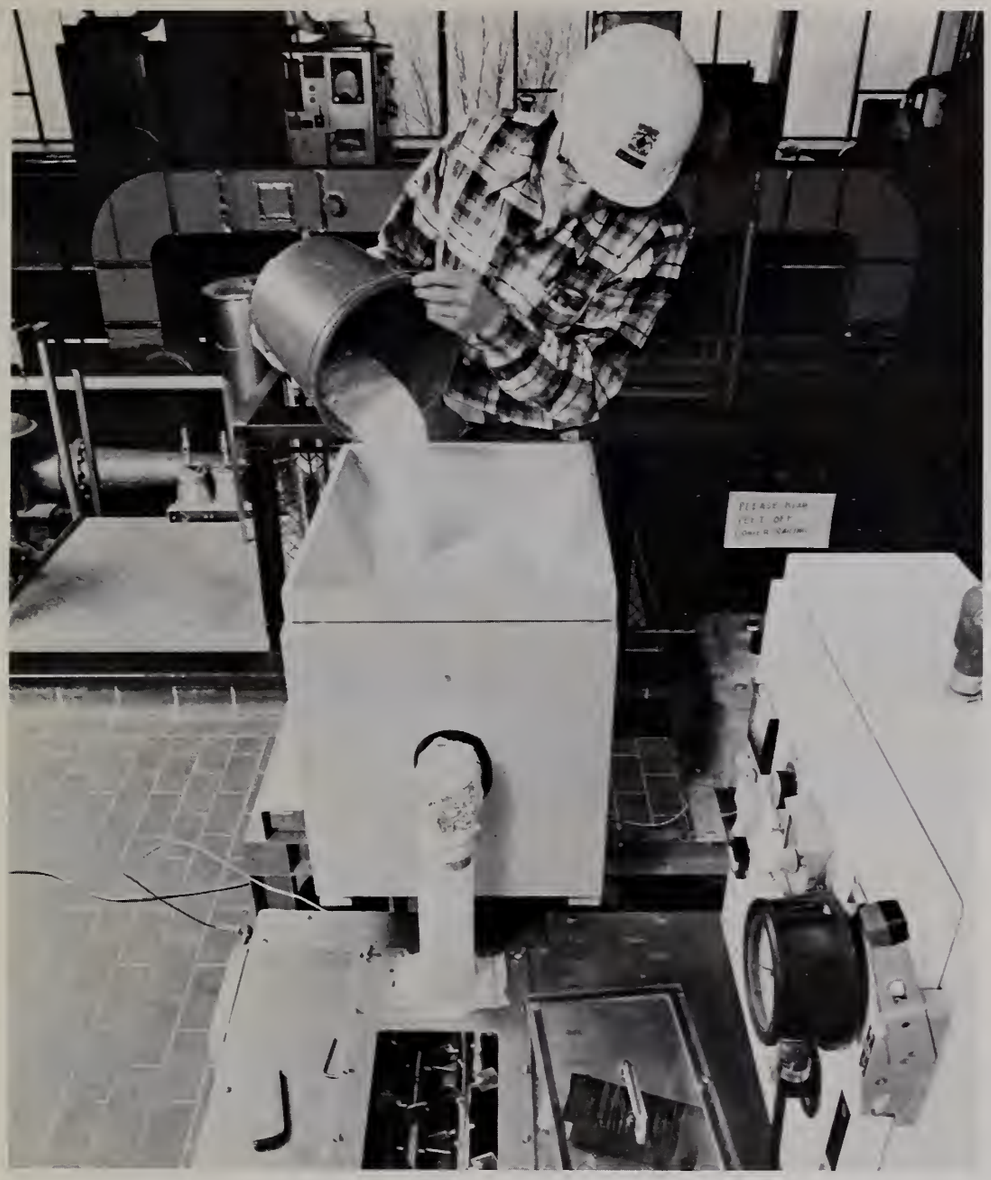


Technician George F. Thompson pours a 5 to 1 mixture of durum wheat and high protein fraction into the dry feeder of a laboratory model pasta press. Strict control is exercised during mixing to maintain proper dough consistency prior to extrusion (0176X84–10).

Whey Makes it Richer

RECENT EMPHASIS on present and future world food problems has stimulated a great deal of national and international concern about the nutritional value of foods. The American consumer, for example, is becoming increasingly aware of the health benefits and the nutritive value of high-quality proteins in the diet.

Food habits being what they are, it is especially important that popular, large-volume items such as macaroni products, cereals, and extruded snack foods provide good nutrition. Their widespread popularity and use in school breakfast and school lunch programs make them prime candidates for nutritional upgrading.

Several packaged protein-enriched food products are currently on the market. Some manufacturers, however, have

Left: Heat coagulation completed, John D. Wankewicz, a co-op student from Drexel University, Philadelphia, Pa., removes the insolubilized high protein whey fraction from the centrifuge bowl (0176X82–30). ***Right:*** *The "cake" is then pelletized, slurried, and spray dried (0176X82–21A).*

tended to use wheat, corn, and soy flours exclusively as sources of added protein. Although the cereal and soy proteins are important and valuable sources of nutritious foods—especially when used in combination—whey protein is even better.

Research by engineers Howard I. Sinnamon, Edwin F. Schoppet, and Curtis Panzer at the Eastern Regional Research Center, Philadelphia, Pa., shows that macaroni enriched with high quality whey protein yields products with nutritional value equal to that of casein, the major protein of milk and cheese. The process is uncomplicated, requiring no change or modification in the commercial macaroni production process. Moreover, preliminary taste panel tests indicate that the whey protein-enriched macaroni is highly acceptable.

The key to this new fortified food product is the heat-coagulated protein obtained from cottage cheese whey. Whey is the aqueous product remaining after removal of casein and fat from milk in the process of making cottage cheese. Cottage cheese whey contains more lactic acid than the "sweet whey" from Cheddar, Swiss, and such Italian cheeses as Provolone and Mozzarella.

Although whey generally contains about one-half the total milk solids and is rich in amino acids, vitamins, lactose, and highly nutritious soluble protein, it is, nevertheless, 93 to 94 percent water. The food industry has become increasingly interested in utilizing whey proteins in various foods. Several methods useful for concentrating and fractionating whey proteins have been developed, such as reverse osmosis, polyphosphate precipitation, gel filtration, ultrafiltration, and heat coagulation. Besides being the simplest and most economical, heat coagulation results in a water-insoluble whey protein product needed in the intended application.

The process of heat coagulation involves holding the whey at a high enough temperature and for a sufficient length of time for the proteins to become insoluble and form a curd or clot. Up to 60 percent of the whey proteins can be coagulated in this way. In experiments designed to determine optimum conditions for heat coagulation, the ARS engineers achieved the best results by adjusting the whey to pH 6.0, heating it to 250°F, and holding at that temperature for up to 8 minutes. However, the calcium salts of whey are insoluble above pH 5.8; thus, this particular process results in a product with a high (20 to 25 percent) ash content.

For applications where high ash content might be undesirable, the whey slurry containing coagulated protein can be acidified with acetic acid to pH 4.6. This serves to redissolve the calcium salts before final separation of the insoluble protein. This step reduces the ash content of the dried protein product to less than 5 percent.

Related tests show that spray drying of whey is preferable because it yields a powdered product directly. Other methods, such as freeze-drying, drum-drying, and cross-circulation-drying yield a hard, caked product that must be ground before use.

The ARS enginers tested several high-protein fractions containing varying amounts of soluble whey proteins;

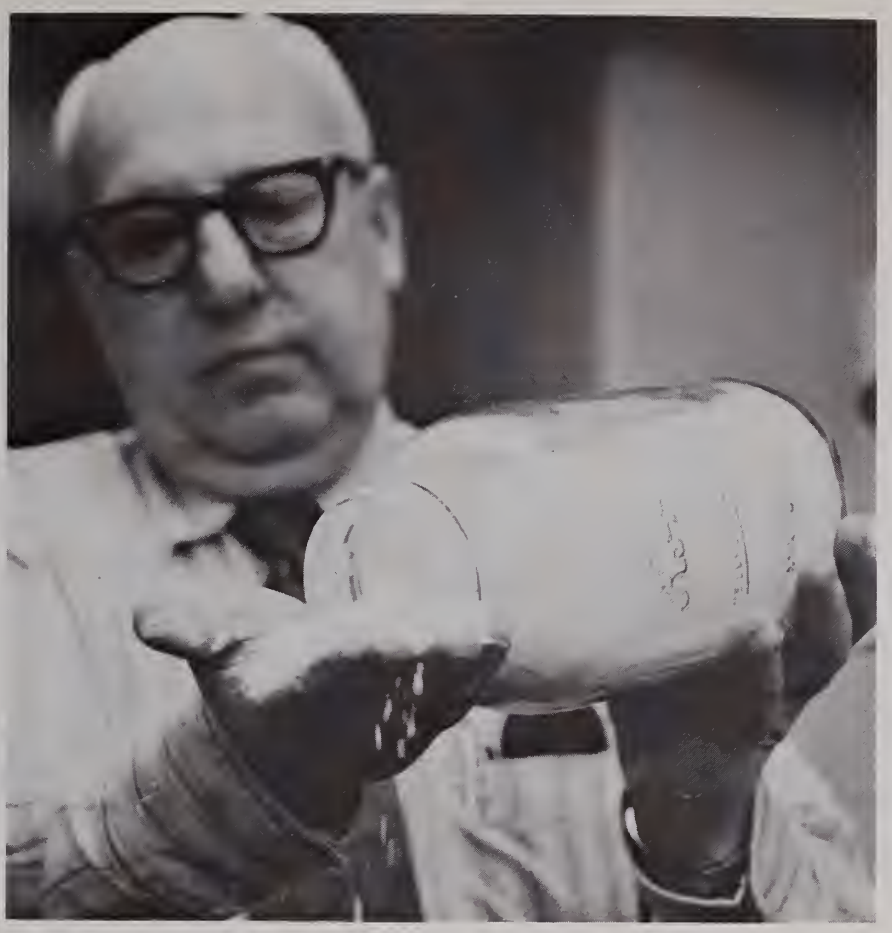
however processing difficulties precluded their use. In contrast, the engineers encountered no processing difficulties with the insoluble, heat-coagulated protein; analyses showed that it retained its amino acid balance throughout the manufacturing, drying, and cooking of the macaroni.

Common macaroni has a protein content of about 13 percent; therefore, sufficient whey protein was incorporated to bring the total protein content up to 20 percent—the standard set for the National School Lunch Program. Results from animal feeding tests designed to quantify nutritive value (protein efficiency ratio or PER) indicate that the added whey protein substantially improved the food value of macaroni.

PER is a widely used index of protein nutritive value and is defined as the grams of weight gain per gram of protein eaten by weaning rats. Common macaroni gave a corrected PER value of 0.80, whereas the whey protein-enriched macaroni had a corrected PER value of 2.5, not significantly different from the standard casein. Incidentally, the heat-coagulated insoluble protein alone had PER values ranging from 2.8 to 3.1.

The plain and protein-enriched macaroni products were also subjected to comparative flavor and texture tests. The trained taste panel detected a difference in the texture, but the difference was not enough to render the protein-enriched product unacceptable. Similarly, the panel also detected differences in flavor, but both the flavor and texture differences became insignificant when tomato or cheese sauces were added to the test samples. As a matter of comparison, the taste panel consistently preferred the whey protein-enriched macaroni samples over samples enriched to 20 percent protein now commercially available at retail.

The success of this research suggests that whey protein can be used to upgrade the nutritional value of other processed foods such as breakfast cereals and extruded snacks.—*T.S.S.*



Mr. Sinnamon examines high protein whey fraction after heat coagulation and spray drying (0176X82–11).

Mr. Schoppet and Mr. Sinnamon evalute whey protein-enriched macaroni for dough consistency, piece uniformity, general appearance, and color (0176X83–33).

Dr. Joppa removes the anthers or male organs from a flower to permit pollination by another wheat plant. Then he will make crosses of the 15 chromosome wheat plants to identify the genetic characteristics carried by the extra chromosome (1175X2283–2, the inset photo; 1175X2283–10).

Genetics to the rescue

AN ADVANCE in basic cereal genetics may eventually improve acceptance of U.S. durum wheats in overseas markets.

By adding a pair of spring wheat chromosomes to durum wheat, ARS geneticist Leonard R. Joppa has increased protein content and improved protein quality in semolina (flour) milled from durum.

Spaghetti and macaroni manufacturers in Italy, an important overseas market, have criticized the low gluten-protein content of durum imported from this country. About half of our durum crop is exported.

The added pair of chromosomes increased the protein content of semolina from experimental durums by 2 to 3 percent—from the usual average of about 13 percent to 15 or 16 percent—and also greatly improved dough strength.

Semolina is used mainly in spaghetti, macaroni, noodles, and other pasta products. About 80 percent of the U.S. durum crop is grown in North Dakota, along with substantial amounts in Minnesota, Montana, South Dakota, and recently in Arizona.

Semolina from the new durums may eventually be suitable for breadmaking, Dr. Joppa says, giving growers an alternate market in years of high production. Spring and winter wheat flours have the high gluten-protein content needed in producing yeast-leavened bread and rolls. Bakers seldom use durums now grown because of poor milling and baking qualities and the yellow color of semolina.

Durum and the common wheats—which include spring and winter varieties used in bread and pastries—are separate species, Dr. Joppa explains. They are similar in appearance, growth habit, and general adaptation but have a different number of chromosomes.

Durum has 14 different chromosomes—the A and B sets of seven chro-

mosomes each. Common wheat, with 21 different chromosomes, has A, B, and D sets of seven chromosomes each. The A and B sets of chromosomes appear to be very similar in the two species, he says, but many of the differences between these species may be genetically controlled by D chromosomes.

Dr. Joppa, in cooperation with North Dakota State University, Fargo, created a durum with 15 pairs of chromosomes by adding the 1D pair (first D chromosomes) from the variety Chinese Spring.

He was guided by results of an earlier study at the Northern Regional Research Center, Peoria, Ill., in selecting the 1D pair of chromosomes. ARS chemist Jerold A. Bietz and associates identified three chromosomes (1D, 1B, and 4D) as principally responsible for glutenin content of common wheat kernels. Glutenins are the proteins controlling mixing quality characteristics in bread doughs.

The 1B chromosome is in both common and durum wheats, but 1D and 4D are not. Of the three, the 1D chromosome may best differentiate glutenin contents of common and durum wheats, Dr. Bietz suggests.

Dr. Joppa selected a Chinese Spring line with four copies of the 1D chromosome and none of the 1A chromosome and crossed it to the durum variety Langdon. After selfmating for the two generations, he backcrossed resulting plants with 14 pairs of chromosomes to Langdon. Further backcrossing and selection resulted in a durum plant with 15 pairs of chromosomes.

Dr. Joppa says repeated backcrossing to Langdon should have eliminated most Chinese Spring chromosomes other than the 1D chromosome responsible for improving protein content and quality.—*W. W. M.*

There's protein in brassica

A leafy green vegetable from the highlands of Ethiopia, *Brassica carinata,* a relative of collard and mustard greens, may be a promising source of plant protein.

Chemists Harold E. Brown, Eduardo R. Stein, and Guadalupe Saldana of the Food Crops Utilization Laboratory in Weslaco, Texas, confirm that analysis of juice pressed from ground leaves shows *Brassica carinata* to be a good source of lysine and other essential amino acids (AGR. RES., Jan. 1971, p. 13). Juice yields ranged from 60 to 70 percent. Protein in the expressed juice was about 100 lbs. per acre. Total protein yield, juice and cake, ranged from 400 to 500 lbs. per acre.

Amino acid analysis of the protein revealed that the protein was similar to alfalfa, soybean, and other plant protein. Immature plants make an excellent leafy green vegetable. Young plants are suitable for machine harvest, and may be cut and canned or frozen following the same procedures used for collard or mustard greens. The flavor of the greens is milder than that of collards and without the pungency of mustard greens. The amount of protein produced per acre is considerable because the yields of greens per acre are large, averaging 17 tons per acre in this study.

Brassica carinata is also a good source of xanthophyll and carotene and thus a good ingredient for poultry rations.

Good plant yields per acre coupled with the ease of protein isolation by heating the juice makes this an attractive source of plant protein.

The Texas Agricultural Experiment Station, Weslaco, cooperated in research to explore the potential of *Brassica carinata.*—*E.L.*

Narrow rows pay

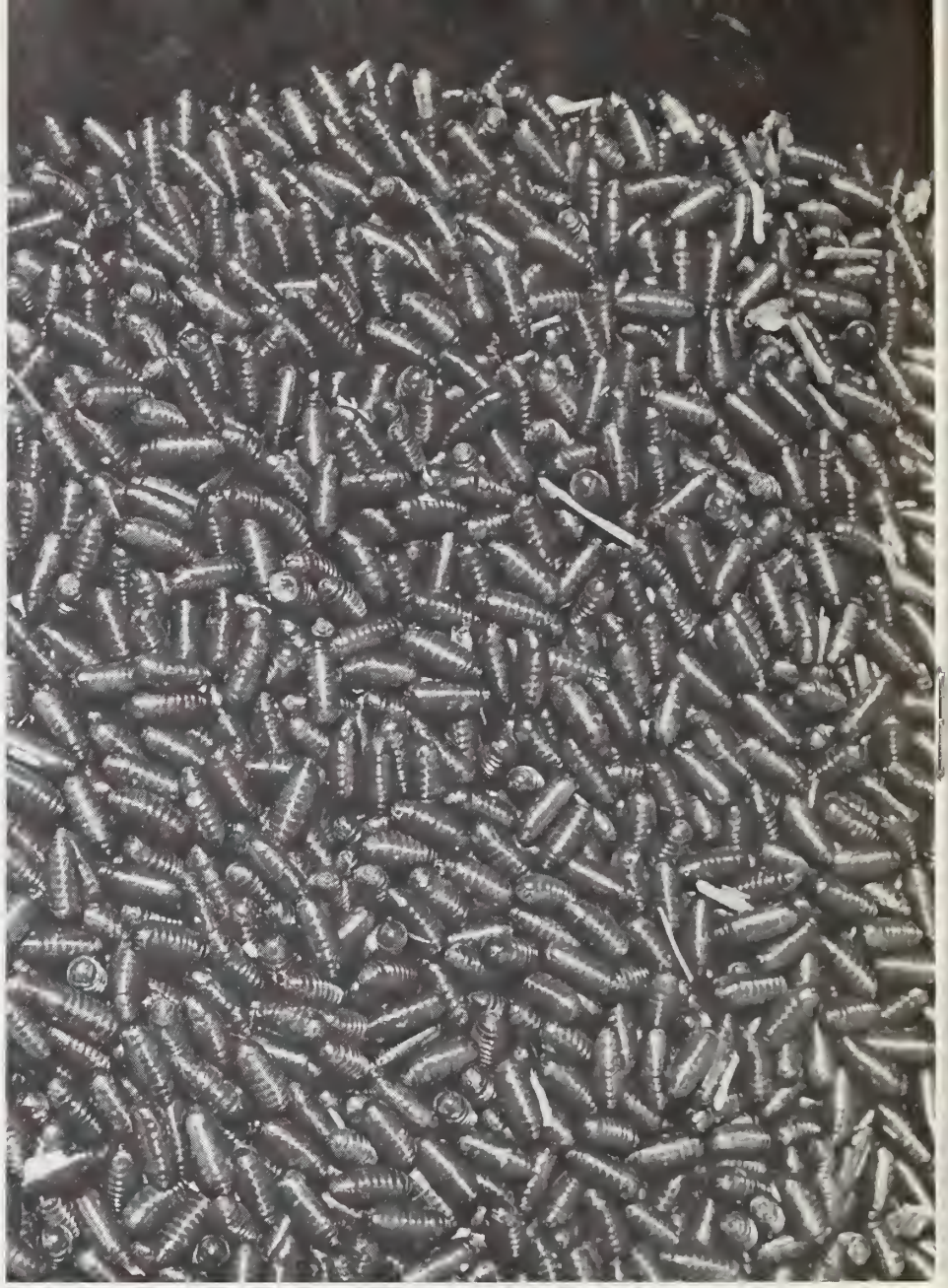
NARROW row spacing can make for wide profit margins by increasing yields of dryland grain sorghum 15 to 20 percent.

Narrow row spacing of sorghum provides an earlier and more complete leaf canopy than conventional spacing. This leaf canopy intercepts more sunlight and rainfall, increases water intake by the soil, and reduces evaporation. Soil water measurements taken during and at the end of the growing season showed no significant difference in soil water content between narrow and conventional row spacing. This suggests that sorghum planted in closer rows uses water more efficiently than sorghum planted in conventional rows.

Spacing sorghum in 27 to 30 inch rows instead of the usual 40 inch rows increased the value of the yield approximately $30.00 per acre in an ARS study in Central Texas. Moreover, narrow row spacing involved no additional production costs, and was accomplished with conventional farming equipment.

The study was conducted by soil scientists John E. Adams, Joe T. Ritchie, and Earl Burnett, and agricultural engineer Clarence W. Richardson of ARS in cooperation with agricultural engineer Gerald F. Arkin, Texas Agricultural Experiment Station, Temple.

The research team found that besides increasing crop yields and conserving water, narrow row spacing cut down soil erosion significantly by reducing runoff.—*B.D.C.*



House fly pupae that have been parasitized by the wasp *Spalangia endius* (0176X133-32).

Death knell for the house fly?

If a pair of house flies mated today, and if their descendants all lived and reproduced normally, their offspring would cover the earth several feet deep 4 months from now. In manure or garbage one pair of flies can increase to 1.8 million pairs within six generations or 12 weeks.

The common house fly, *Musca domestica* L., is capable of carrying typhoid, cholera, amoebic dysentery, leprosy, tuberculosis, and plague—to mention only some of the common diseases of man.

Where swatting, spraying, trapping, and even sanitation measures have failed, a tiny wasp may succeed in controlling this major pest which is truly cosmopolitan, existing wherever man has established himself.

Continuing research in Florida and St. Croix, V.I., has shown that parasitic wasps can be reared economically and released in large numbers to suppress

Dr. Morgan prepares a wasp release station at a 4,200-bird egg production house which is infested with a large population of house flies. To bring the fly population under control, he will put out 250,000 parasitized pupae per week in six release stations at this site over a period of 10 weeks. Within 24 hours, the wasps emerge from the pupae, mate, and fly through the screen enclosure to seek host pupae (0176X133–22).

Dr. Morgan examines wasp-parasitizing house fly pupae. He is rearing 4 million of the wasps each week for release near Gainesville, Fla., against selected concentrations of the house fly (0176X132–25).

or eradicate populations of house flies.

The tiny wasps lay their eggs in the immature stage, or pupa, of the fly and the wasp then feeds on the fly until it eventually causes death. Outstanding among the group of wasps that show promise as control agents is *Spalangia endius* Walker, which has been found in fly pupa 8 inches below the surface of garbage.

The life history of the minute wasp is as colorful as it is lethal. The female is ready to mate and lay eggs as soon as she emerges from the fly pupa, and proceeds through four distinct phases.

She finds the area where the host is present, finds the fly pupa, drums and drills, and oviposits and feeds. Once she has found a pupa, she systematically examines its surface while drumming with the tips of the antenna. Then she begins tapping the surface of the puparium with the antenna, and finally taps with the tip of the abdomen. This activity places the tip of the ovipositor in place for drilling, a procedure that requires 10 minutes to an hour.

When the wall of the puparium is pierced, the entire length of the ovipositor is inserted, and one egg is deposited on the developing fly. Then she withdraws the ovipositor and feeds by ingesting the blood of the fly flowing from the wound. After her meal, the wasp departs to find another pupa.

During the next 33 to 35 days, the wasp egg develops to a mature adult and in the process completely destroys the house fly, which had served as a source of food for the developing wasp. The cycle represents a highly economical form of plunder. A major plus for man lies in the fact that the wasps do not bother or harm animals or humans.

"In the past," said entomologist Philip B. Morgan, "biological control by releases of wasps to control natural populations of flies in the United States and Europe have not been effective. We believe these failures occurred because insufficient numbers of wasps were released in proportion to the existing house fly population.

"In our first successful attempt, we made continuous releases of *Spalangia* at a small caged poultry installation in northern Florida. Within 30 days the releases completely suppressed the house flies, and all house fly pupae collected from the site 37 days after the release were parasitized."

Dr. Morgan, entomologist Richard S. Patterson, and biological technician Arthur Benton further evaluated the potential of the wasp to control flies in two field tests. At a commercial poultry farm the house fly population was suppressed and all pupae collected were parasitized within 4 weeks. In a test at a calf barn at a commercial dairy, fly control ranged from 83 to 93 percent within 31 days, and all pupae collected were parasitized.

Sustained releases will increase wasp populations to the point that the wasp will reduce the density of flies and keep it at a low level, the researchers said.

"This method of fly control is relatively inexpensive and would eliminate the problems that are ordinarily associated with pesticides," Dr. Morgan said at the Insects Affecting Man Research Laboratory in Gainesville, Fla.—*P.L.G.*

Food technician Carol A. Hudson fills and weighs individual servings of puffy omelets. Each of these portions weighs 150 grams and can be served with any of several sauces (1075X2094–20).

Easy eggs for breakfast

PERHAPS more people would sit down to a nutritious breakfast if it were more convenient to prepare. For many people, mornings are the most rushed part of the day. People who eat breakfast prefer an easy-to-prepare meal, such as dry cereal. But these breakfasts often lack the flavor and some of the nutrients that eggs can provide.

In an effort to encourage people to eat good and hearty breakfasts, scientists have adapted frozen convenience breakfasts originally developed for personnel at Air Force missile bases. These convenience breakfasts contain at least one egg per serving and include western or Denver eggs; egg and potato patties; creamed eggs with beef, turkey, or chickens; french toast; puffy omelets; and potato pancakes.

Eggs are a popular and versatile food for a satisfying breakfast because they are one of our most nutritious foods. They have high quality protein and are rich in many of the essential minerals and vitamins. Eggs also are relatively low in calories—about 80 for a large egg.

These frozen products, developed at the Western Regional Research Center, Berkeley, Calif., in cooperation with the U.S. Army Natick Laboratories, Natick, Mass., are easy to prepare. They are simply removed from the freezer and baked for about 2 minutes in a microwave oven. Baking times in a conventional oven vary from 11 minutes for french toast to 60 minutes for puffy omelet; most, however, require about half an hour. The oven does all the work with these foods, leaving time to prepare for work, school, or do household chores.

"Taste panels rated all these products high," says food technologist Lee-Shin Tsai. "I expect that consumer acceptance will be just as favorable."

Although these products can be prepared by conventional operations and standard equipment, the Center is currently mechanizing the production process so that it can be adapted by the food industry.

ARS researchers have learned that the most successful way to freeze egg products is through the use of blends of yolk and white, addition of approved stabilizers, and substitution of more stable food ingredients for those that break down when frozen. These products can be stored for at least 6 months at 0°F.—*D. H. S.*

Exploiting between-herd genetics

SIGNIFICANT genetic differences exist between herds of the same beef cattle breed as well as within herds. And these between-herd differences for certain growth and carcass traits can be exploited in breeding for more efficient meat production.

Cattlemen have had no method for evaluating separately the influences of genetic and environmental variations on herd performance. Lacking information to the contrary, the vast differences in performance of beef herds have been attributed primarily to between-herd variation in environment, including management practices and climate.

A study at the U.S. Meat Animal Research Center, (USMARC) Clay Center, Nebr., shows, however, that important between-herd differences in genetic potential have evolved.

ARS animal geneticists Larry V. Cundiff, Keith E. Gregory, and Charles R. Long separated and evaluated the relative importance of between-herd and within-herd sources of genetic variance, using birth, growth, and carcass data on more than 800 calves. The study was in cooperation with the American Angus Association, the American Polled Hereford Association, and the University of Nebraska, Lincoln.

The researchers found that sources of genetic variation between herds significantly influenced percentage calving difficulty, birth weight, 200-day weight, postweaning average daily gain, 452-day weight, final carcass grade, and carcass conformation grade.

Genetic diversity between herds was greater for growth traits than for carcass traits, Dr. Cundiff reports. Differences between herds are of some value for appraising breeding value for yearling weight, he said, but not for weaning weight because of large environmental differences between herds. The scientists found similar ranges of genetic diversity between the Angus and Polled Hereford herds represented in the study.

Between-herd genetic variation can be identified by either of two techniques coming into use that remove between-herd environmental differences, Dr. Cundiff says. Sires from a number of herds can be brought together for progeny test in a single herd. Or progeny performance of individual sires can be measured against that of a reference sire in a multiherd national sire evaluation program.

Beef cattle record of performance programs that express progeny performance of individual sires as deviations from herd average do not account for genetic diversity between herds, Dr. Cundiff points out. Such comparisons may underestimate or overestimate the breeding value of individual sires in relation to breed average, depending upon whether they are produced in herds of above- or below-average genetic merit for the breed.

The study was, in effect, a progeny test at USMARC of 51 bulls from 18 Angus herds and 44 bulls from 18 Polled Hereford herds. The bulls were mated by artificial insemination to Angus and Hereford cows to produce straightbred and crossbred calves also used in another study.

The Angus and Polled Hereford Associations provided semen from sires in herds randomly selected from those involved in the associations' record of performance programs. Two to four bulls ranging from around average to near top in yearling weight were sampled from each herd. The bulls had been bred in the herd, been evaluated for growth through a year of age in groups of 12 or more of similar age, and were less than 3 years of age (so progeny records could not influence selection).

Birth, livability, weaning, and carcass data on calves produced during two seasons from the matings were analyzed statistically to partition and evaluate between-herd and within-herd genetic variations.—*W.W.M.*

Toxic proteins

Above: Chemist Ellen Lew conducts thin layer chromotography to identify the amino acids in a peptide sequence (1075X2100–26A). Below: Chemist Charles C. Nimmo louds a peptide sample into the reaction chamber of an automatic sequencer. This laboratory device shoots off amino acid from the peptide sequence (1075X2098–15).

IMAGINE that for just one day you could not eat any foods containing wheat. That would eliminate breads, pastries, crackers, many breakfast cereals, some soups and gravies, and many other foods you never imagined contained wheat—licorice candies, for example. You would probably readily admit that this would make quite a change from your normal diet, and would also present a challenge in selecting wheat-free foods.

There are people—about 1 out of every 2,000 in the United States and 1 out of every 300 in western Ireland, for example—who must do this every day of their lives. They suffer from celiac disease, a condition that seems to be largely hereditary. In this condition the gliadin proteins of wheat trigger a highly specific immune response in the small intestine. This immune response changes the tissue so that the capacity of the small intestine to absorb nutri-

ents is greatly diminished.

The resulting malabsorption of proteins, fats, carbohydrates, vitamins, and minerals can stunt the growth of children or cause a severe loss of weight when the condition develops in adults. Foods containing wheat usually cause celiac patients to develop diarrhea and other symptoms of intestinal distress.

At present, the only practical way to control the symptoms of celiac disease is to completely remove wheat from the diet—along with rye and barley. Rice, corn, and soy, however, seem to be safe foods in the diets of celiac patients.

Although it is known that the gliadin proteins of wheat are responsible for celiac disease, it is not known if all, or only some, of the proteins in this complex mixture are responsible.

At the Western Regional Research Center, Berkeley, Calif., chemists John E. Bernardin, Charles C. Nimmo, Ellen J. L. Lew, and Donald D. Kasarda are seeking to identify the toxic proteins. They are cooperating with another research group at the National Institutes of Health (NIH) led by Warren Strober, a physician and immunologist.

In addition to identifying the toxic proteins, the researchers hope to determine the specific part of the protein molecule that is responsible. Proteins may be thought of as long strings of beads with amino acids corresponding to the beads. Only a short length of these amino acids linked together in a definite sequence may be the culprit.

The ARS group separates gliadin proteins from the wheat and breaks them down to peptides (groups of amino acids) by chemical or enzymatic means. The NIH group tests the proteins and peptides by using an organ culture method they devised. In this method, a tiny sample of tissue is obtained from the small intestine of celiac patients by means of a biopsy capsule and tube passed down the throat.

This tissue is cultured for 48 hours and then examined for changes in enzyme activity. The sample is toxic if the development of normal enzyme activity is inhibited. The researchers also study the immune responses that inhibit the enzyme development.

When the toxic factor has been identified and its distribution among the proteins determined, the ARS scientists will evaluate the possibility of removing it from wheat by genetic manipulation. However, if the toxic factor is too widely distributed and such removal may prove impossible, then other solutions would be sought.

A side benefit of the research is that it adds to our basic understanding of the workings of the immune system. Such understanding could lead to the control of many other diseases that involve immune responses.—*D.H.S.*

and celiac disease

Technician Norma E. Hague prepares the culture medium in which the tissue samples will be tested for their response to gliadin peptides (1075X2099–22).

After tissue samples are obtained from patients with celiac disease, Dr. Strober prepares them for the culture medium (1075X2099–13).

Citrus with a schnoz

SHEEPNOSING, a malformation of grapefruit whose exact cause is unknown, results in poor consumer acceptance in the market place.

Research conducted at Weslaco, Texas, by ARS horticulturist Heinz Wutscher reveals that temperature, humidity, and geographic location play an important role in citrus malformation. External and internal fruit quality characteristics of citrus are strongly influenced by climate.

Sheepnosed, or stem-end tapered, grapefruit have an elongated shape. The stem end is depressed and surrounded by a collar which gives the fruit a snoutlike appearance.

Sheepnosing is always associated with thick rinds, puffiness, and open centers. Young trees are more likely to bear sheepnosed fruit. The condition tends to be more prevalent in inland desert growing areas than in coastal areas.

While these characteristics have been observed by citrus researchers around the world, Dr. Wutscher sought to induce sheepnosing in order to study its effects. Analysis of different treatments in a controlled growth chamber environment revealed that 90° F day and 45° F night temperatures induced severe sheepnosing. Fruit grown under a 90° F day and 87° F night temperature had creased stem ends. A 90° F day and 75° F night temperature produced normal fruit.

Scientists suspect that variations in climate affect growth regulators in the fruit, leading to abnormal fruit shape. Although fruit flavor and sugar content are unaffected by sheepnosing, sheepnosed grapefruit and oranges are poorly accepted by consumers and thus are a concern of ARS citrus researchers.—*E.L.*

Sheep adapt to halogeton

EXPERIENCED western sheepmen know that flocks can be gradually introduced to range containing the poisonous plant halogeton without injury. But unrestricted grazing by sheep unaccustomed to halogeton may produce dramatic losses.

Cooperative studies at the Poisonous Plants Research Laboratory, Logan, Utah, and the National Animal Disease Center, Ames, Iowa, confirm that the difference in tolerance to oxalate, the toxic substance in halogeton, is probably related to differences in the bacterial population of the sheep's rumen. Tolerance to amounts of oxalate that would kill unadapted sheep develops, ARS microbiologist Milton J. Allison suggests, with selective increases of anaerobic rumen bacteria able to degrade oxalate.

Dr. Allison and colleagues fed sheep increasing amounts of halogeton until it constituted 30 percent of the diet on the fifth day. The rate of oxalate metabolism was measured in rumen contents taken from the sheep.

Oxalate breakdown was about seven times greater 48 or more hours after halogeton was added to the diet than when the sheep were fed alfalfa. Breakdown was most rapid 4 to 8 hours after feeding halogeton. Infusion of sodium oxalate into the rumen of another sheep similarly affected the breakdown rate.

In a related study, oxalate metabolism also increased when continuous cultures of ruminal microbes were fed halogeton or infused with sodium oxalate. Rumen bacteria rather than protozoa appeared to be active in breaking down oxalate, and metabolism was inhibited by exposure of rumen contents to air.—*W.W.M.*

AGRISEARCH NOTES

Plants under stress

CAN PLANTS tell us when they are under stress before it is too late to correct the situation? By the time a plant's suffering becomes visible, serious and possibly irreversible damage has already been done.

Plant pathologist Robert G. Linderman of ARS and plant physiologist David Tingey of the Environmental Protection Agency, working cooperatively at the Ornamental Plants Research Laboratory, Corvallis, Oreg., have been trying to determine if there is a universal quantitative indicator of plant stress. They think they may have succeeded.

Plants under stress release ethylene gas which can be measured on a gas chromatograph. Research indicates that monitoring a plant's production of ethylene gas can serve as a yardstick to measure when a plant is under stress and how that plant is holding up to the stress.

Insects seems to be aware of such gaseous indicators of plant stress. Bark beetles, for instance, attack sick trees that apparently release gases which the bark beetle senses and homes in on.

Dr. Linderman is hopeful that release of ethylene gas can be used to indicate plant stress caused by plant pathogens, air pollution, moisture excess or drought, root pruning, transplanting, as well as shipping and handling. Furthermore, a reliable monitor of stress would allow researchers and growers to pin-point the factors causing the stress so that they could be corrected.—*L.C.Y.*

Buried alive

A 50-YEAR BURIAL STUDY began in 1972 may be, ultimately, more optimistic than gloomy for farmers. The object of the experiment is to determine how long weed seeds will live in the soil—information farmers need to know if they are to win the perennial war against crop-choking weeds like johnsongrass, spurred anoda, and velvetleaf.

At Stoneville, Miss., weed seeds were collected from 20 locally grown species, mixed with soil and each buried in three plastic screen bags at soil depths of 3, 9, and 15 inches. During the next 50 years, seeds will be periodically recovered and tested for germination and viability, research that may help wipe out costly weed infestations.

The viability of fresh, stored, and exhumed seeds was determined by germination tests and tetrazolium red treatments, a stain indicating life. Control seeds were stored at the National Seed Storage Laboratory at Fort Collins, Colorado. Before burial or storage, seed viability was above 90 percent for all species except prostrate spurge, johnsongrass, and Texas panicum. They rated 83, 82, and 80 percent viable, respectively.

At the Southern Weed Science Laboratory, plant physiologist Grant H. Egley and agronomist James M. Chandler determined the percentages of seeds still alive in the soil after burial for 2½ years: for example, less than 10 percent of the white morningglory, redroot pigweed, prostrate spurge, prickly sida, redvine, Florida beggarweed, and barnyardgrass seeds were still alive in the soil. But over 50 percent of the velvetleaf, johnsongrass, small moonflower, and spurred anoda seeds were alive. Of the original 20 kinds of weed seeds, only chickweed was dead.

The percentages were based on the averages of the three burial depths; in general, depth of burial appeared to have little effect on seed survival.

Even if the farmer kills all emerged weeds, he will need to control the weeds germinating from these seeds in infested fields for at least three cropping seasons, report Dr. Egley and Dr. Chandler.

The scientists' prediction: longer-lived weed species will require many more years—the number yet undetermined—of pre- and post-emergence control.—*P.L.G.*

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Bacteria and a new carrot disease

SCIENTISTS have identified two bacteria species that together caused a new and serious disease in carrots grown in the Rio Grande Valley of Texas in 1975.

From carrot tips, the bacterial infections advanced up the cores, softening, discoloring, and hollowing them, said biological technician David B. Towner who conducted research on the problem with plant pathologist Louis Beraha at the ARS Market Pathology Laboratory, Chicago.

"One of the bacteria species we identified, *Erwinia chrysanthemi*, had never been known to affect carrots before," said Mr. Towner. The other bacteria, *Erwinia caratovora*, previously had been found attacking carrot crowns—not the cores.

At the peak of the outbreak in the Valley, the core-rot disease infected up to 30 percent of the carrots that were bulk-shipped to food processors. However, carrot varieties grown for and shipped to fresh produce markets showed no evidence of the disease, said Mr. Towner. The reasons are still to be learned for some carrots being infected while others are not.

An external symptom of core-rot, slight decay at the carrot tip, did not appear until after harvest. But produce inspectors in the Rio Grande Valley found the internal symptoms in mature carrots from low-lying portions of fields where water frequently accumulated.

The roles that maturity and soil moisture may have in aggravating carrot core-rot have not yet been thoroughly studied, the researchers say, nor have other conditions that may affect carrots' susceptibility to the disease.—*G.B.H.*

Recovering saline soils

SALINE SOIL PATCHES in nonirrigated farm fields in the Rio Grande Valley reduce crop production and lower the value of the land. Research conducted by ARS engineers Robert J. Rektorik, Ronald R. Allen, and Leon Lyles near Raymondville, Texas, indicate that interspersed saline and nonsaline nonirrigated soils can be leveled to reclaim the saline soils for crop production.

Landforming a field so that the saline soils are leveled to a plane 9 centimeters (cm) lower than nonsaline soils allowed high intensity rainfall to run off the nonsaline soils and pond onto the saline areas. Retaining incident rainfall on the saline soils in excess of their infiltration rate also reduced salinity. Both processes increased the amount of rain water percolating through the saline soils to leach excess salts from the root zone.

Tests show that soil salinity for the 0 to 90 cm and 0 to 180 cm saline profiles was reduced 53 and 37 percent, respectively, during the 4-year study. Salinity in the nonsaline soil profiles was reduced 16 percent for both depth increments. The higher net salt removal from the saline profiles tended to even out the salt content of the field. This balance permitted more uniform plant growth and increased yields. Grain sorghum and cotton yields were 71 and 38 percent greater than yields from an adjacent untreated field. The researchers report that the increased revenue from the yield increases more than paid the $125 per hectare cost of leveling the field.—*E.L.*

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

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